

LFG-1310
FUNCTION GENERATOR
SERVICE MANUAL

NOTE

These servicing instructions are for use by qualified personnel only. To avoid electrical shock, do not perform any servicing other than that contained in the service manual unless you are qualified to do so.

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1. SPECIFICATIONS

Frequency Range:	0.01Hz to 10MHz, 9 ranges
Accuracy:	x0.01 to x100k ranges . . . $\pm 5\%$ of full scale x1M range . . . $\pm 10\%$ of full scale
Waveforms:	Sine wave, triangle wave, square wave, ramp wave, and pulse wave
Sine wave:	
Flatness:	0.01Hz to 100kHz . . . ± 0.3 dB 100kHz to 10MHz . . . ± 1 dB
Distortion:	10Hz to 50kHz . . . 0.5% or less
Triangle wave:	
Linearity error:	1% at 100Hz
Square wave:	
Rise/fall time:	25ns or less (with max. output)
Symmetry Variation:	20:80 to 80:20 (0.01Hz to 1MHz)
Operation Mode:	
CW:	Continuous generation
TRIG/GATE:	TRIG . . . one cycle oscillation triggered by input signal GATE . . . oscillation only when input is HI
Frequency range:	0.1Hz to 1MHz
Input voltage:	TTL
Input frequency:	DC to 100kHz
Start/stop phase:	Variable
BURST:	Burst wave oscillation for gate time of 1ms to 10s by built-in oscillator. ON/OFF time is symmetrical and variable.
SWEEP:	
Sweep mode:	Selection of linear and logarithmic sweep;
Sweep time:	1ms to 10s, 2 ranges, continuously variable. Fly-back line interval is symmetrical and variable.
Sweep width:	Max. 1:100, continuously variable (sweep start frequency can be specified.)
Output Characteristics:	
Output level:	20Vp-p (output terminal open)
Attenuator:	0, 20, 40, and 60dB, continuously variable
Output impedance:	50ohms $\pm 10\%$
DC offset:	Max. ± 10 V (output opened)
SYNC output:	TTL level (duty cycle are symmetrical and variable.)
GCV output:	Voltage output in proportion to frequency, 0 to 5V (max. frequency in each range)
SWEEP output:	Sweep output in sweep mode, 0 to -5 V
SWEEP/BURST gate out:	TTL level
Amplitude Modulation (AM):	Modulation level . . . 0 to 100%, continuously variable Input signal level . . . max. 5Vp-p Suppressed-carrier mode
External Control of Frequency (VCG):	
Frequency range:	Max. 1000:1, with frequency dial set to "10"
Input level:	0 to -5 V ($\pm 20\%$) (frequency is decreased by negative voltage)
Power Supply:	100 VAC $\pm 10\%$ 50/60Hz 30VA 120, 200, 220, and 240V available by adjusting the power transformer tap
Size and Weight:	300(W) x 100(H) x 300(D)mm, approx. 3.5kg
Accessories:	Connection cable: LC-204B (50-ohm BNC-clip cable) x 1 Instruction manual x 1 Option: 50-ohm terminator LT-2049

- Remarks: 1. The specifications described above are applicable at a temperature of 23°C $\pm 5^\circ$ C and a relative humidity of 40 to 85%.
2. Unless otherwise stated, the frequency dial is set to 1 to 10, and SYMMETRY is set OFF for the specification data.

2. TEST EQUIPMENT REQUIRED

The following test equipment is required for calibration and servicing of the Model LFM-1310. The suggested specifications are the minimum necessary for proper calibration of this instrument.

<u>Test Equipment</u>	<u>Minimum Spec</u>
- Multimeter	0 - 20V Accuracy < 0.1% 3-1/2 digit
- Oscilloscope	10mV sensitivity 100MHz bandwidth Delayed sweep Low capacitance probe
- Frequency Counter	0.01Hz - 10MHz
- Distortion Meter	1kHz 1% full scale
- Audio Generator	1kHz sine wave
- Function Generator	100kHz TTL signal
- 50 ohm Terminator	Feedthrough

3. CALIBRATION PROCEDURE

3.1 General

- Calibration should be performed after a 30 minute warm-up period. It should also be confirmed that the unit is connected to the rated power line voltage.
- During the adjustment procedure, remove the case only when necessary and replace immediately after making an adjustment. This will maintain all circuits at constant operating temperature.
- All adjustments should be completed in the given order, because some adjustments interact with others.

3.2 Initial Control Settings

- The initial control settings to be used for each check and adjustment are listed below. Any variations from these settings are stated in the applicable procedure.

FREQ Dial	10
FREQ RANGE	x100
MODE	CW
FUNCTION	Sine wave
OUTPUT	
DC OFFSET	OFF
ATTENUATION	0dB
VARIABLE	Fully clockwise
SWEEP/BURST/AM MOD	
SYMMETRY	OFF
VARIABLE	Center
AM CARRIER LEVEL	0
TIME	1-100mS
START/MOD LEVEL	Center
SET	START
LIN-LOG	LIN
AM	OFF
TRIG START LEVEL	Center
SYMMETRY	OFF

3.3 Power Supply

- Connect the DC voltmeter between TP3(+17V line) and/or TP4(-17V line), on the pc board(T-3571), and chassis.
- Adjust VR8(T-3571) so that the voltages at the TP3 and TP4 are exactly same absolute value.

- Check all supplies according to Table 3-1.

<u>Voltage</u>	<u>Test point</u>
+14V	D43(T-3570) anode
-14V	D44(T-3570) cathode
+6V	Junction of R53 and R54
+5V	IC13(T-3570) pin3
+5V1	D42(T-3570) cathode

Table 3-1

3.4 Offset Adjustment-1 (Current source)

- Set: FREQ Dial Fully counterclockwise
FREQ RANGE x100
- Connect the DC voltmeter between TP4 and TP5(T-3570).
Note the voltage reading to three places of decimal.
Remove the voltmeter.
- Connect the DC voltmeter between TP2 and TP3(T-3570).
- Adjust VR3(T-3570) for exactly same voltage as above noted.

3.5 Buffer Amplifier

- Set: FREQ Dial Fully counterclockwise
FREQ RANGE x100
FUNCTION Square wave
SYMMETRY On
 - Connect the oscilloscope to OUTPUT connector and set the
TIME/DIV control to 0.1mS, SLOPE button to +. Adjust TIME
VARIABLE control for 1 cycle display.
- (1) Bias Adjustment
- Adjust VR6(T-3570) to the center of the stable oscillation
range when rotate the SYMMETRY control at both extreme
positions.
- (2) Symmetry Checking
- Expand the negative going edge, located at the center area
of the graticule, 100 times using the delayed sweep mode of
the oscilloscope as shown in Figure 3-1.



Figure 3-1

Observe this point

- The displacement of the positive and negative going edge should be less than 0.4%(4 divisions) when switch the SLOPE button between + and -.

3.6 Offset Adjustment-2 (Tuning Amplifier)

- Connect the junction of R1 and VR1(T-3570) to chassis by short clip lead.
- Connect the DC voltmeter to TP2(T-3570).
- Adjust VR2(T-3570) for a voltmeter reading of 0.000V.

3.7 Frequency Adjustment-1(1kHz)

- Set:

FREQ Dial	10
FREQ RANGE	x100
FUNCTION	Square wave
- Connect the frequency counter to OUTPUT connector.
- Adjust VR1(T-3570) for a frequency reading of 1.005kHz.

3.8 Symmetry Adjustment-1(Dial "1")

- Set: Same as 3.7
- Connect the frequency counter to OUTPUT connector.
- Connect the oscilloscope to SYNC OUT connector and set the TIME/DIV control to 0.1ms/DIV for 1 cycle display.
- Connect the DC voltmeter to TP1(T-3570) and note the voltage. Call the voltage -V.
- Rotate the FREQ Dial clockwise until the voltage reading becomes -V/10.

- Adjust VR4 and VR5(T-3570) alternately to obtain an 100Hz, symmetrical square wave.

3.9 Dial Settings

- Set: FREQ Dial 1
FREQUENCY RANGE x100
- Connect the frequency counter to OUTPUT connector.
- The frequency reading should be between 97Hz and 103Hz.
- If not, reset the FREQ Dial by two set screws on the dial knob for frequency reading of 100Hz then repeat step 3.7 and 3.8 to re-adjust the frequency.

3.10 Frequency Adjustment-2(10Hz)

- Set: FREQ Dial 10
FREQ RANGE x1
FUNCTION Square wave
- Connect the frequency counter to OUTPUT connector.
- Adjust VR8(T-3570) for a frequency reading of 10.00Hz.

3.11 Symmetry Adjustment-2(x1 RANGE)

- Set: FREQ Dial 1
FREQ RANGE x1
FUNCTION Square wave
- Connect the oscilloscope to OUTPUT connector and set the TIME/DIV control to 0.1S/DIV then expand the sweep width 10 times using horizontal magnifier mode.
- Adjust VR7(T-3570) precisely so that the displacement of the positive and negative going edge of the square wave should be less than 0.5%(0.25 division) when switch the SLOPE button between + and -. Refer to Figure 3-1.

3.12 Frequency Adjustment-3

(1) 1MHz

- Set: FREQ Dial	10
FREQ RANGE	x100k
FUNCTION	Square wave

Connect the frequency counter to OUTPUT connector.

- Adjust VC1(T-3570) for a frequency reading of 1.000MHz.

(2) 10MHz

- Set: FREQ Dial	10
FREQ RANGE	x1M

- Adjust VC4(T-3570) for a frequency reading of 10MHz.

(3) 5MHz

- Set: FREQ Dial	5
FREQ RANGE	x1M

- Check that the accuracy is between 4.8MHz and 5.2MHz.
- If not, adjust VC3(T-3570) so that the frequency reading is 10000 times of the x100 RANGE.
- Repeat the step (1) and (2) if necessary.

(4) 100kHz

- Set: FREQ Dial	10
FREQ RANGE	x10k

- Adjust VC2(T-3570) for a frequency reading of 100.0kHz.

3.13 Sweep Generator

(1) Symmetry Adjustment

Set: SWEEP/BURST/AM MOD	
TIME	1-100mS
TIME VARIABLE	Fully counterclockwise
SYMMETRY	OFF
SET	SWEEP

- Connect the oscilloscope to SWEEP/BURST GATE OUT connector.
- Adjust VR4(T-3569) for a symmetrical square wave.

(2) Anti-log Circuit Adjustment

- Adjust following adjustments on the pc board(T-3570) to obtain a waveform as shown in Figure 3-2.

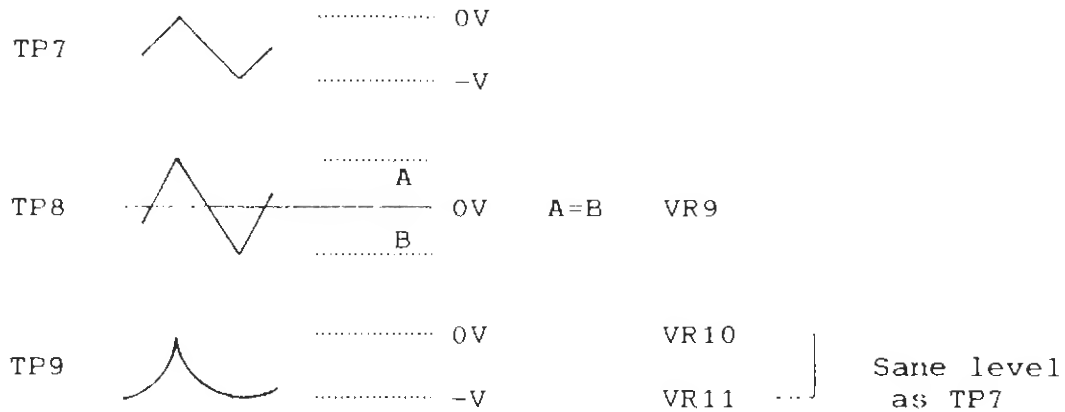


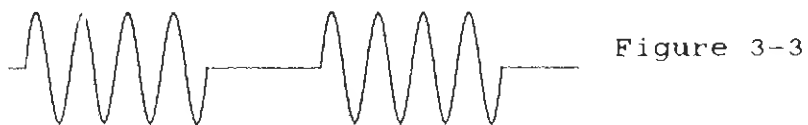
Figure 3-2

3.14 High Frequency Compensation

(1) Gate

- Set:

FREQ Dial	10
FREQ RANGE	x100k
MODE	GATE
FUNCTION	Sine wave
- Connect the oscilloscope to OUTPUT connector via 50 ohm terminator.
- Apply 100kHz TTL signal from the reference function generator to TRIG IN connector.
- Set the TRIG START LEVEL control to obtain a waveform as shown in Figure 3-3.



- Adjust VC5(T-3570) so that the base line becomes as flat as possible with less ringing and overshoot.

(2) Output Amplifier

- Set: FREQ Dial	1
FREQ RANGE	x1M
MODE	CW
FUNCTION	Square wave
ATTENUATION	0dB
VARIABLE	Fully clockwise

- Connect the oscilloscope to OUTPUT connector via 50 ohm terminator.

Adjust VR1-4 and VC1(T-3571) for a flat top square wave.

- Set: FUNCTION Sine wave

- Adjust vertical sensitivity of the oscilloscope for 6 divisions display.

- Set: FREQ Dial 10

- The sine wave amplitude should be between 5.5 division and 6.5 division.

- Repeat above adjustment if necessary.

3.15 Distortion Adjustment

- Set: FREQ Dial	10
FREQ RANGE	x1k
FUNCTION	Sine wave

- Connect the distortion meter to OUTPUT connector via 50 ohm terminator.

- Adjust VR6 and VR7(T-3571) alternately for minimum sine wave distortion.

3.16 AM Modulation

- Set: FREQ Dial	10
FREQ RANGE	x10k
FUNCTION	Sine wave
SWEEP/BURST/AM MOD	
AM	ON
AM CARRIER LEVEL	Fully clockwise
MOD LEVEL	Fully clockwise

- Connect the oscilloscope to OUTPUT connector.
- Connect the sine wave generator to MOD IN connector and set the frequency to 1kHz, output level for 100% AM.
- Adjust CARRIER LEVEL control and VR5(T-3571) alternately for correct DSB(Double Side Band) waveform as shown in Figure 3-4.

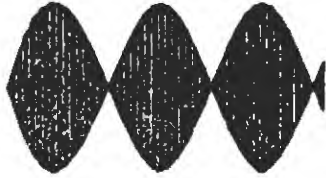


Figure 3-4

4. TROUBLESHOOTING PROCEDURE

4.1 Troubleshooting Aid-1

- Confirm that the any equipment used with the LFG-1310 is operating correctly.
- Check all control settings, because an incorrect setting can make a good unit appear defective. If there is any question about the function, see the INSTRUCTION MANUAL for a correct operation.
- Check all circuit for visual defects such as broken component, loose connections, open wire, poor soldering etc.
- Some troubles can be solved with proper adjustment.
- Check voltage, waveform and state of logic circuit as shown in the "7 BLOCK DIAGRAM/SCHEMATIC DIAGRAM" to trace the defective circuit. Then, troubleshoot the associated circuit and/or the control circuit. Start with the power supply.

4.2 Troubleshooting Aid-2

(1) Overall operation is not satisfactory or unit is "dead".

a. Check the power supplies. Refer to "3.3 Power supply".

Secondary voltage of the power transformer

+17V: Check IC4 and associated circuit (Adjust VR8)

-17V: Check IC5 and associated circuit (Adjust VR8)

+14V: Check D43 and associated circuit

-14V: Check D44 and associated circuit

+6V: Check D9 and associated circuit

+5V: Check IC13 and associated circuit

+5V1: Check D42 and associated circuit

(2) FUNCTION

- a. No triangle wave comes out with CW MODE.
Check that triangle wave is present at TP6.
Yes: Check waveform at pin 1 of P2(T-3571) for triangle wave.
Yes- Check output amplifier(Q1-9, IC1 T-3571) Attenuator(S1, R11-16).
No- Check FUNCTION switch(S2 T-3568), AM ON/OFF switch(S3 T-3569), VARIABLE control(VF4, 5).
No: Check the triangle generator by following procedure.
Apply 1kHz sine wave from audio generator to the gate of Q7(T-3570) and set the amplitude about 10Vp-p.
Check that the clipped sine wave is present at the OUTPUT connector.
Yes- Connect the DC voltmeter to TP1(T 3570). The voltage reading should be between about -60mV and -5.5V when rotate the FREQ dial from fully clockwise to fully counterclockwise. And also, the voltage at the TP3 and 4 are proportioned to the voltage at TP1.
If the voltage changes correct, check current sources(IC4, 5, Q3-6), diode bridge(D3-10 T-3570).
If the no voltage is present, check tuning amplifier(IC1 T-3570) and SYMMETRY control.
No- Check comparator(IC7, Q13-20 T-3570), buffer amplifier(Q7-10 T-3570).
- b. No sine wave comes out
Confirm that the triangle function works correctly.
Yes: Check waveform and DC voltage at the sine wave converter(Q15-20 T-3571), FUNCTION switch and associated circuit.
No: Check the triangle generator.
- c. Distorted sine wave comes out
Adjust VR6, 7(T-3571). Refer 3.16.
- d. No square wave comes out
Confirm that the triangle function works correctly.
Yes: Check FUNCTION switch and associated circuit.
No: Check the triangle generator.
- e. No frequency change or intermittent by rotating FREQ dial.
Check VR1, FREQ RANGE switch and range capacitors(C17-22).
If x1 and lower ranges do not work, check capacitance multiplier(IC6, Q11, 12 T-3570).

- f. No SYMMETRY control works
Check S1, VR1(T-3569) and associated circuit.
 - g. No DC OFFSET works
Check IC1(T-3570) and associated circuit.
- (3) Burst
- a. No burst signal comes out
Check waveform at TP7(T-3570) for triangle wave which frequency is changed by rotate the TIME VARIABLE control.
Yes: Check input signal at following points of burst gate (T-3570).
 - Pin 4 of IC9 for triangle wave
 - Pin 5 of IC8 for square wave
 - Pin 1 of IC8 for square wave
 - DC voltage at pin 9 of IC9 from -6.7V to -12V when rotate TRIG START LEVEL control.
 Yes- Check burst gate(IC8, Q21, 22, 32 T-3570) and associated circuit.
 No Check the signal sources

 No: Integrator(IC10 T-3570), comparator(IC11, 12, Q26-30 T-3570) and associated circuit.
 - b. TRIG MODE
Check one-shot multivibrator(IC1 T-3568) and signal source of TRIG IN connector.
 - c. GATE MODE
Check burst control(IC12 T-3570) and signal source of TRIG IN connector.
 - d. No SYMMETRY control works
Check integrator and comparator(IC10-12, Q26-28 T-3570).
 - e. No TRIG START LEVEL control works
VR2(T-3569) and associated circuit. See (2) a.
- (4) Sweep
- a. Confirm that the CW came out from the OUTPUT connector, also the frequency to be changed by rotating the FREQ dial

b. No sweep mode works

Check waveform at TP7(T-3570) for triangle wave which frequency is changed by rotate the TIME VARIABLE control.

Yes: Check waveform at pin 2 of P3(T-3570).

Yes- Tuning amplifier(IC1 T-3570) and associated circuit.

No Integrator and comparator(IC10-12, Q26-28 T-3570).

No: Check MODE switch and associated circuit.

c. Log sweep does not work

Check antilogarithmic converter(IC14-16 T-3570) and associated circuit

d. No sweep time changes

Check C1, 2(T-3569) and associated circuit.

(5) AM modulation

a. No modulated signal comes out

Check waveform at pin 2 of P3(T-3571) for CW and pin 1 of P5(T-3571) for associated signal from MOD IN connector.

Yes: Check waveform at base of Q12(T-3571) for modulated signal.

Yes- Check output amplifier(Q12-14 T-3571) and associated circuit.

No- Check IC3(T-3571) and associated circuit.

No: Check that the signal sources, MOD LEVEL control(VR5 T-3569) and associated circuit.

(6) Others

a. No SYNC output

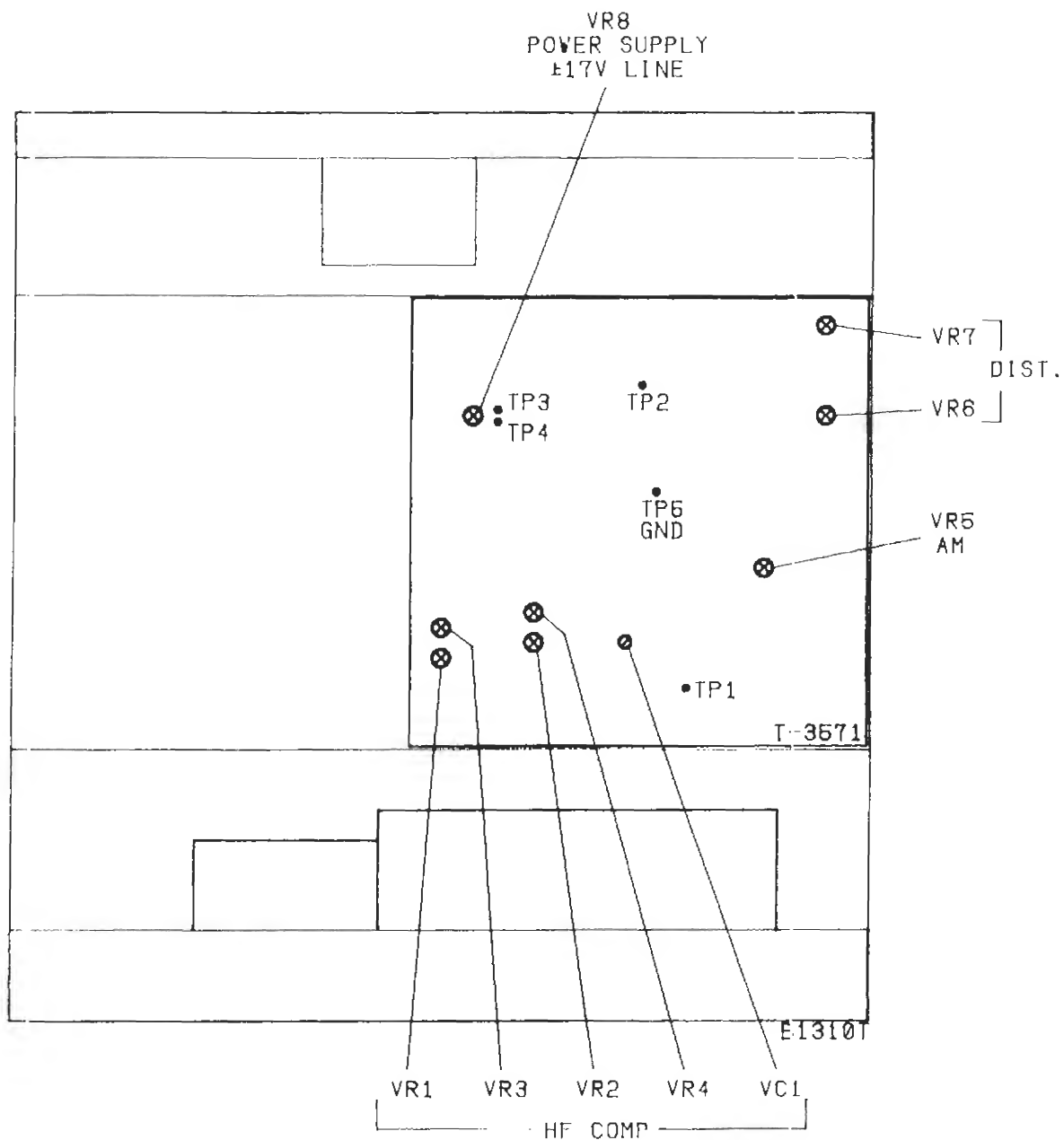
Check sync output amplifier(Q23-25 T-3570).

b. No SWEEP/BURST GATE OUT signal comes out

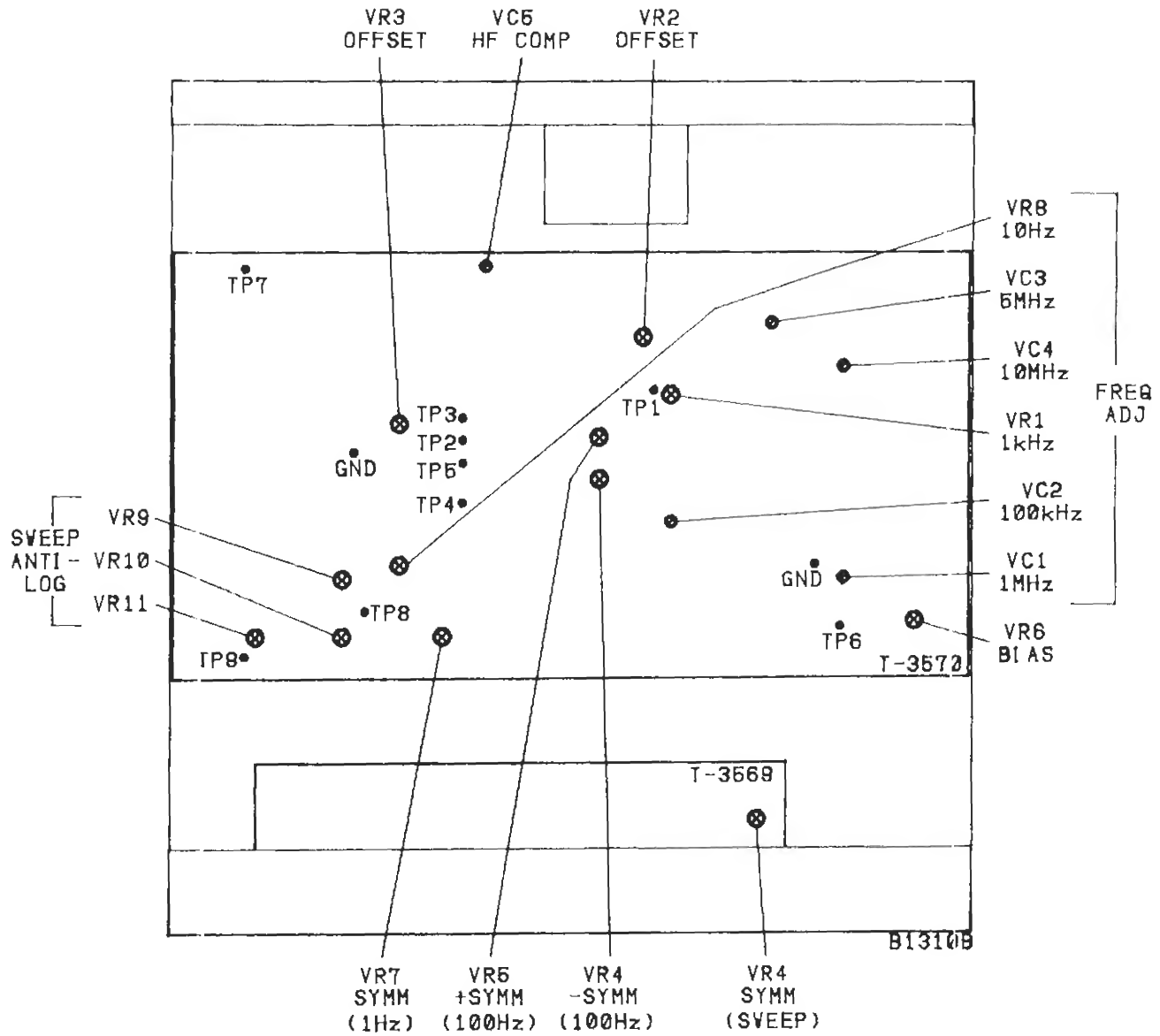
Check Q31(T-3570) and associated circuit.

5. ADJUSTMENT LOCATIONS

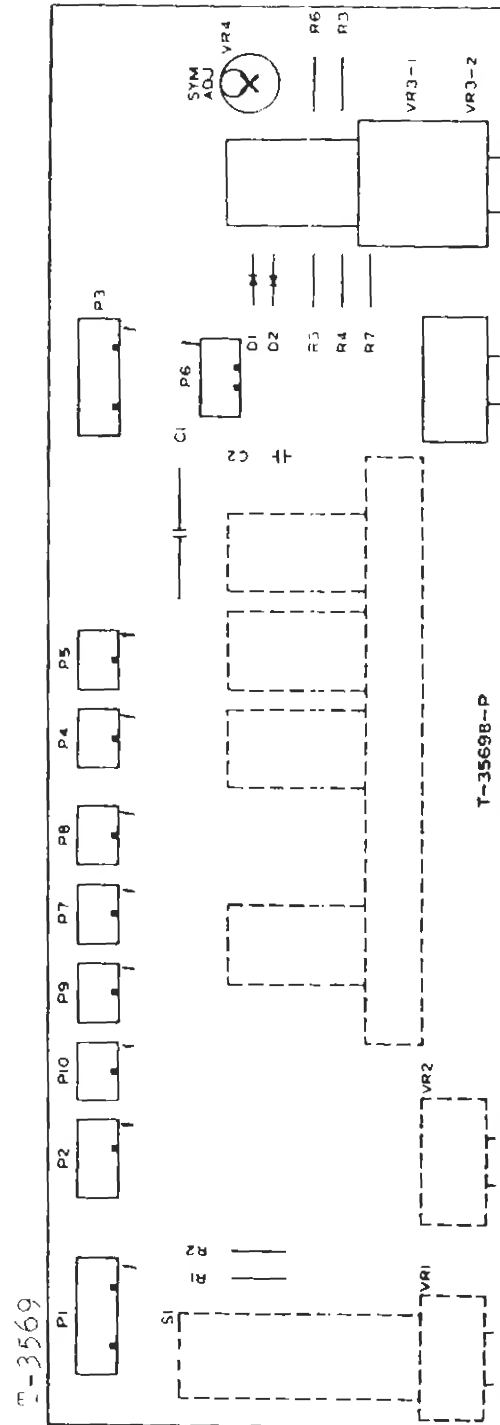
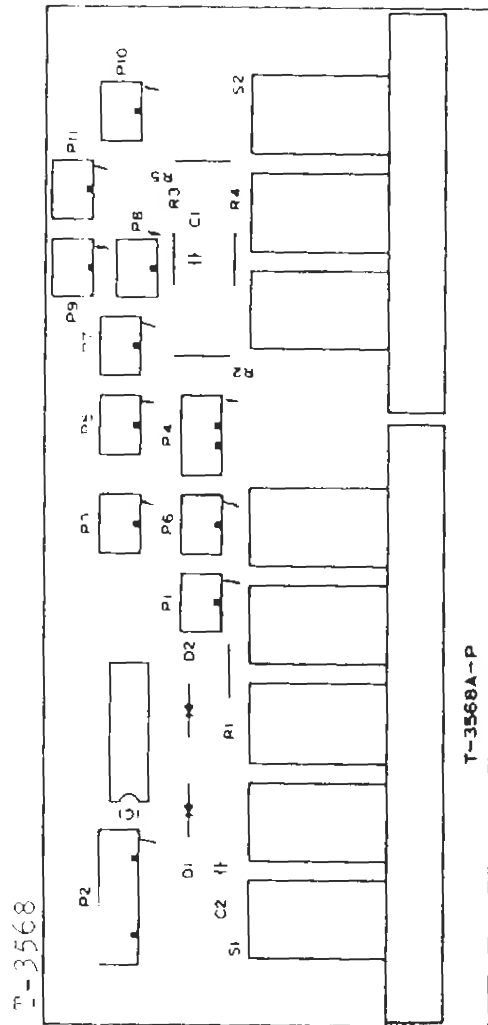
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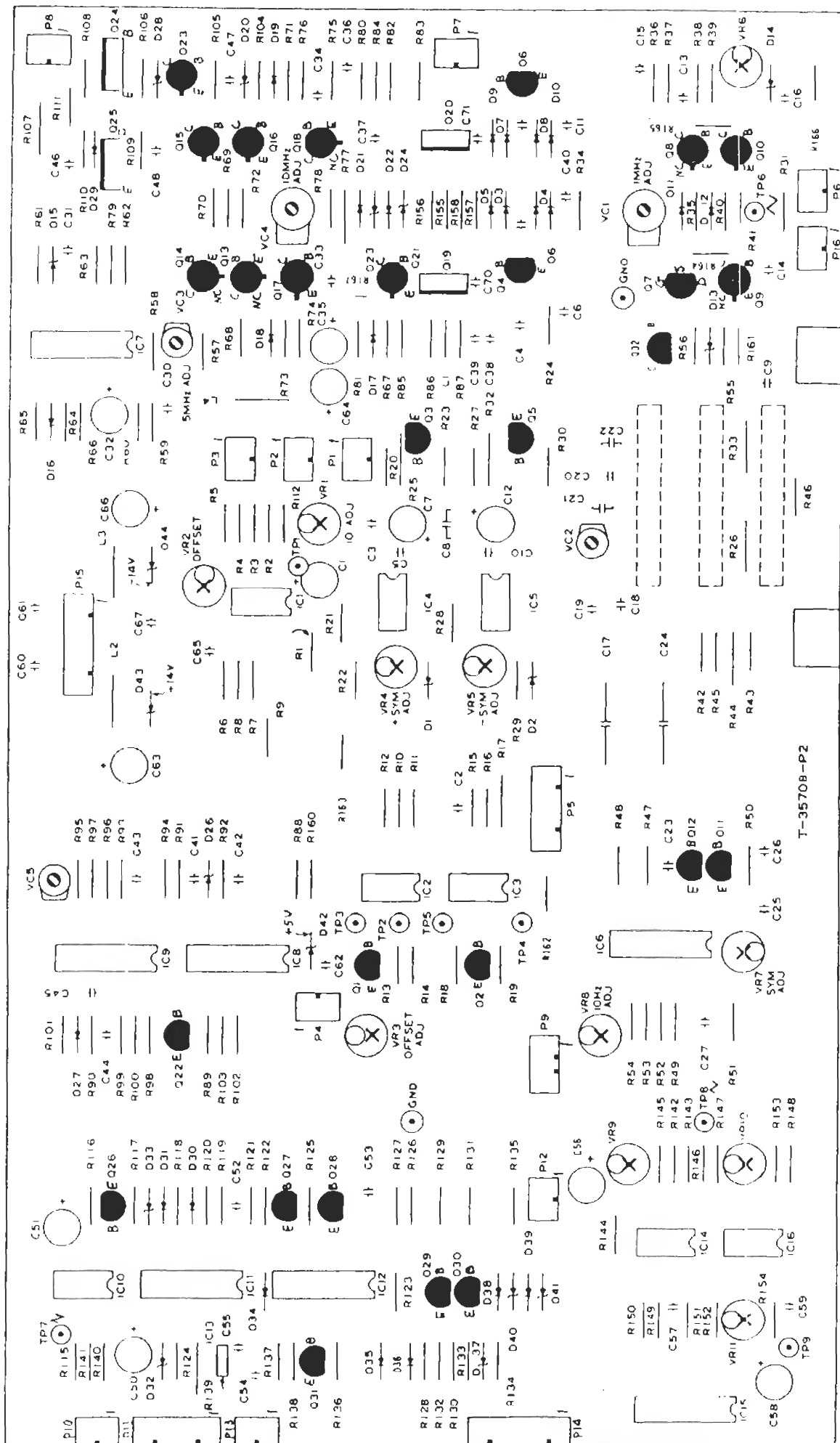
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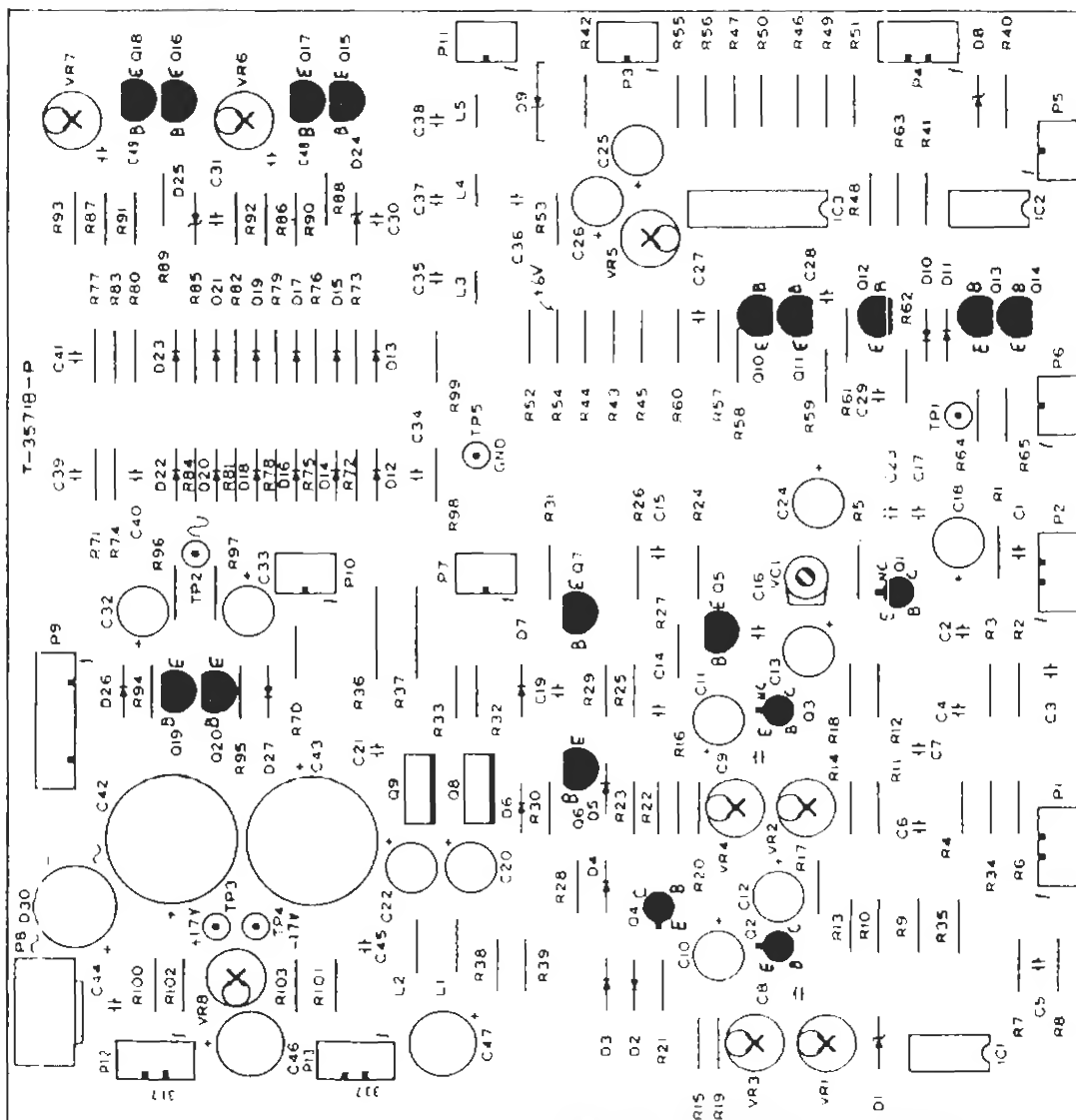
6. PRINTED CIRCUIT BOARD



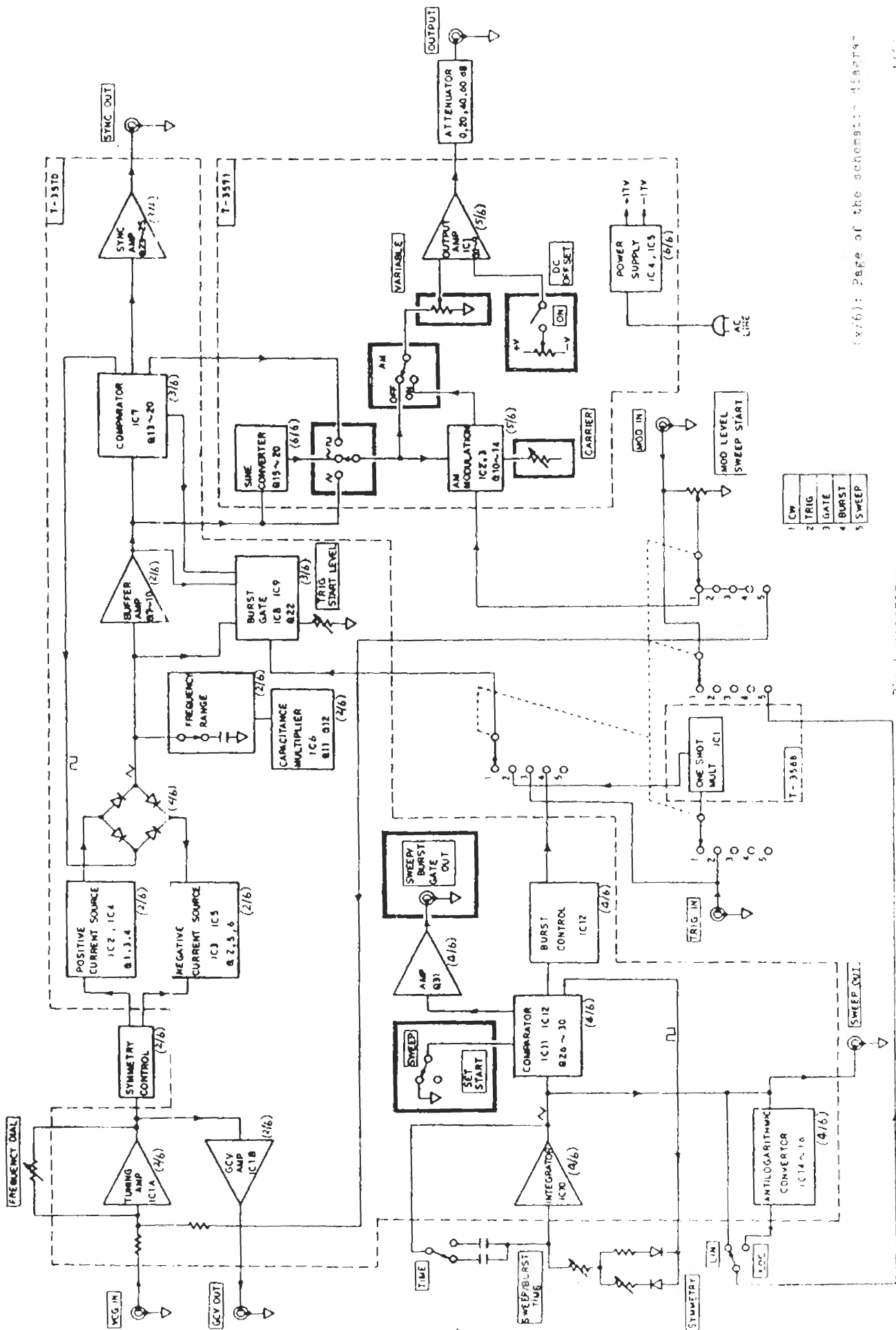
T-3570



T-3571

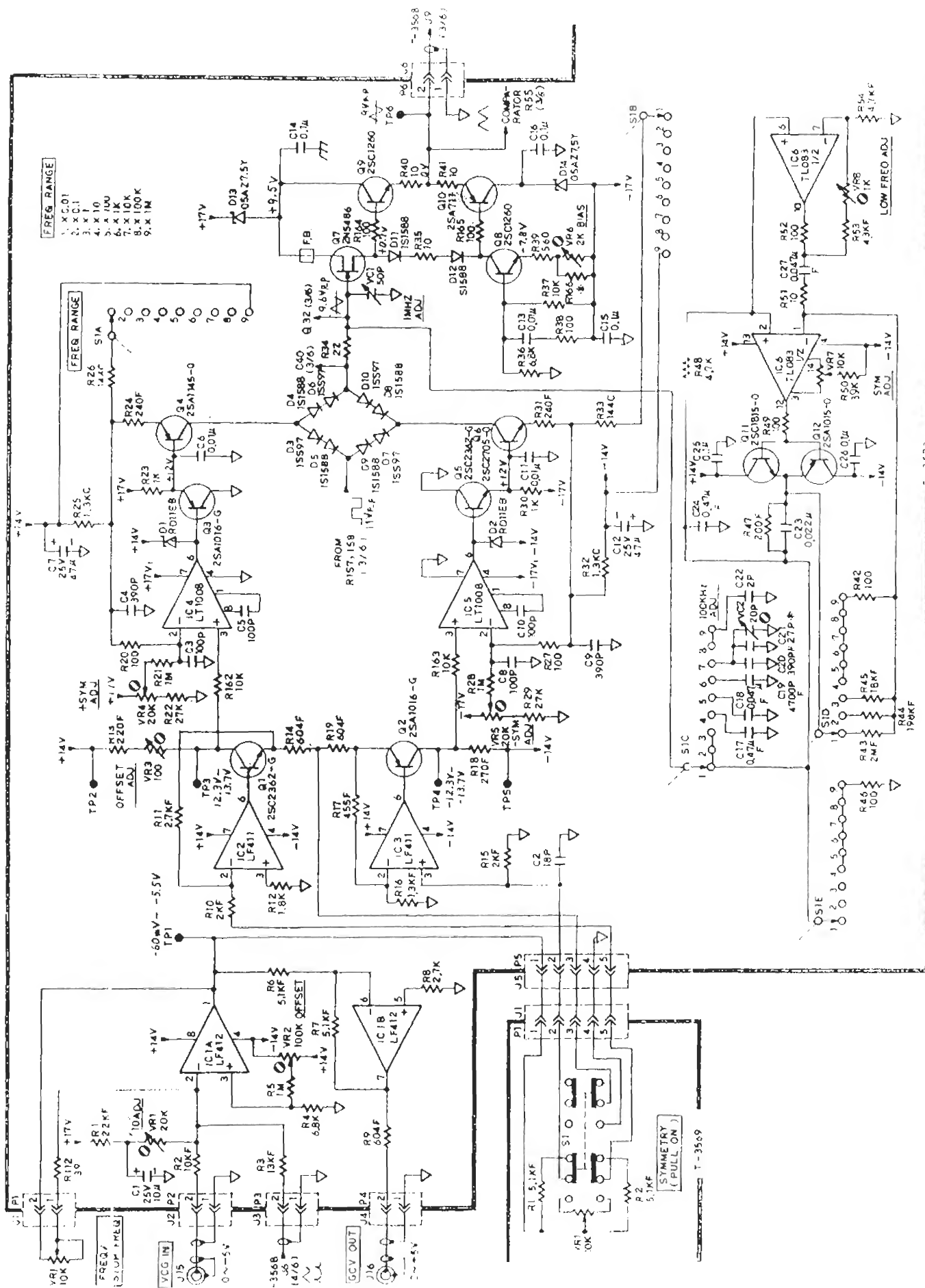


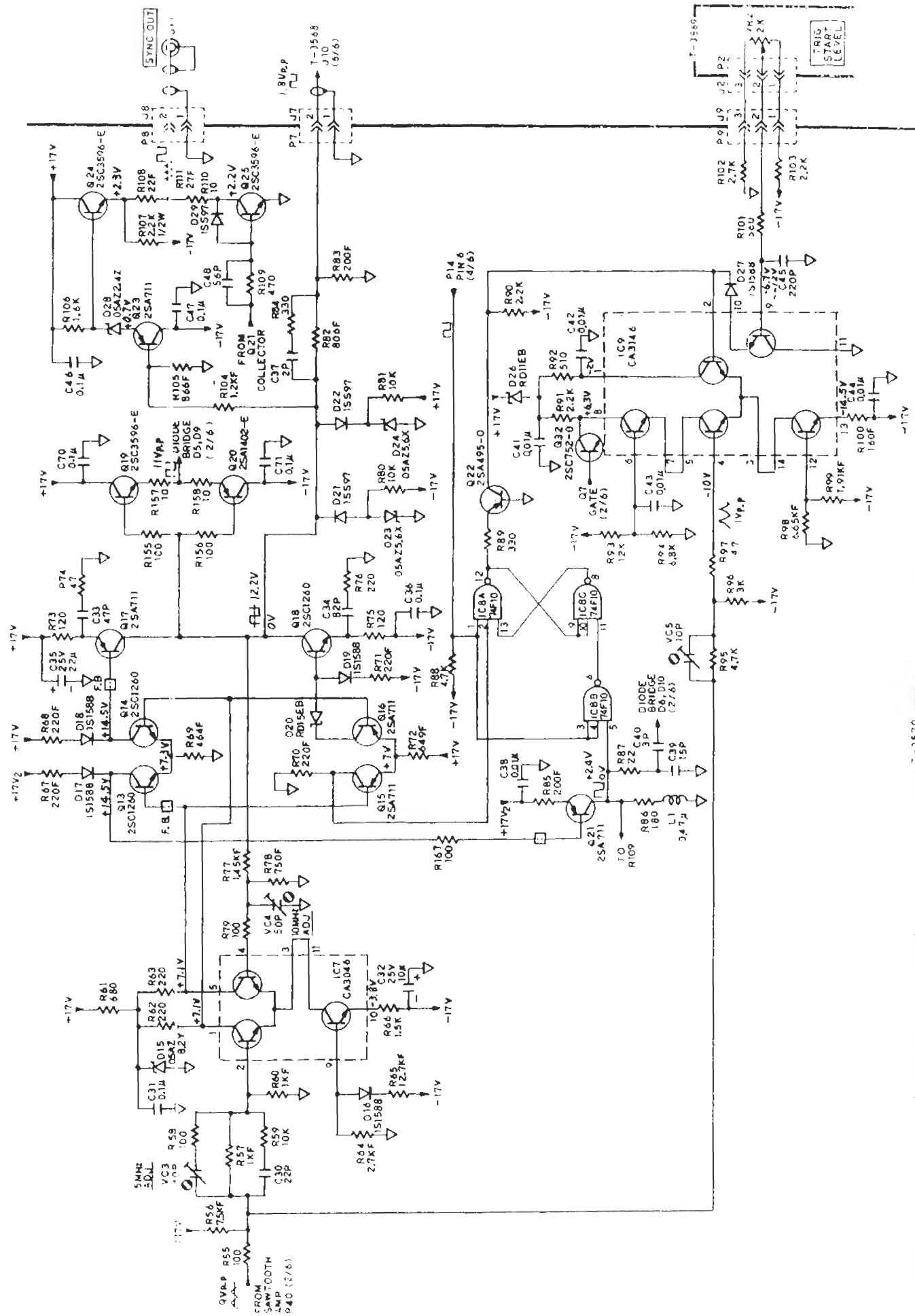
7. BLOCK DIAGRAM/SCHEMATIC DIAGRAM



(x76): Page of the schematic diagram

Block Diagram

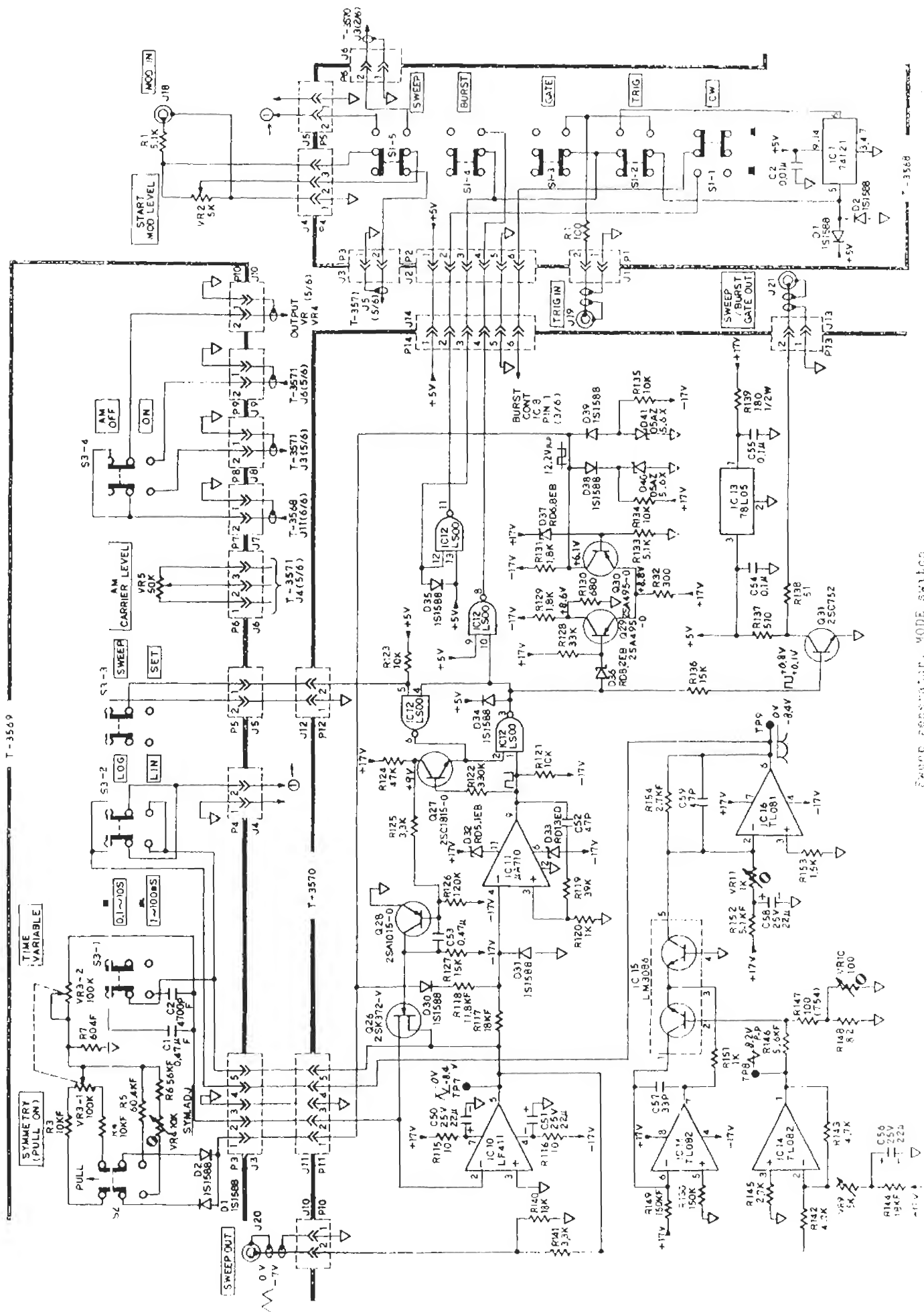




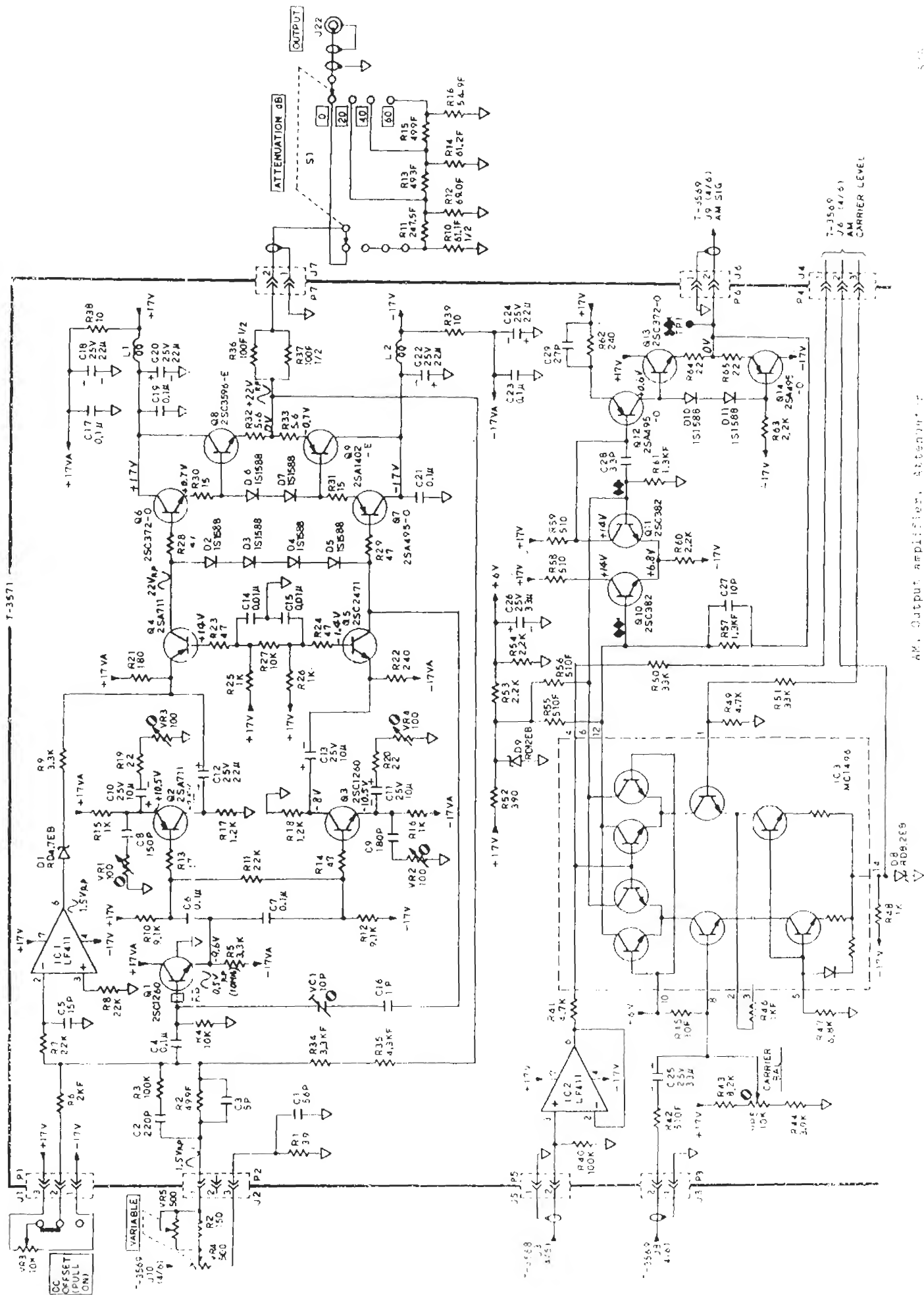
Computer, Burat, Sync

T-3570

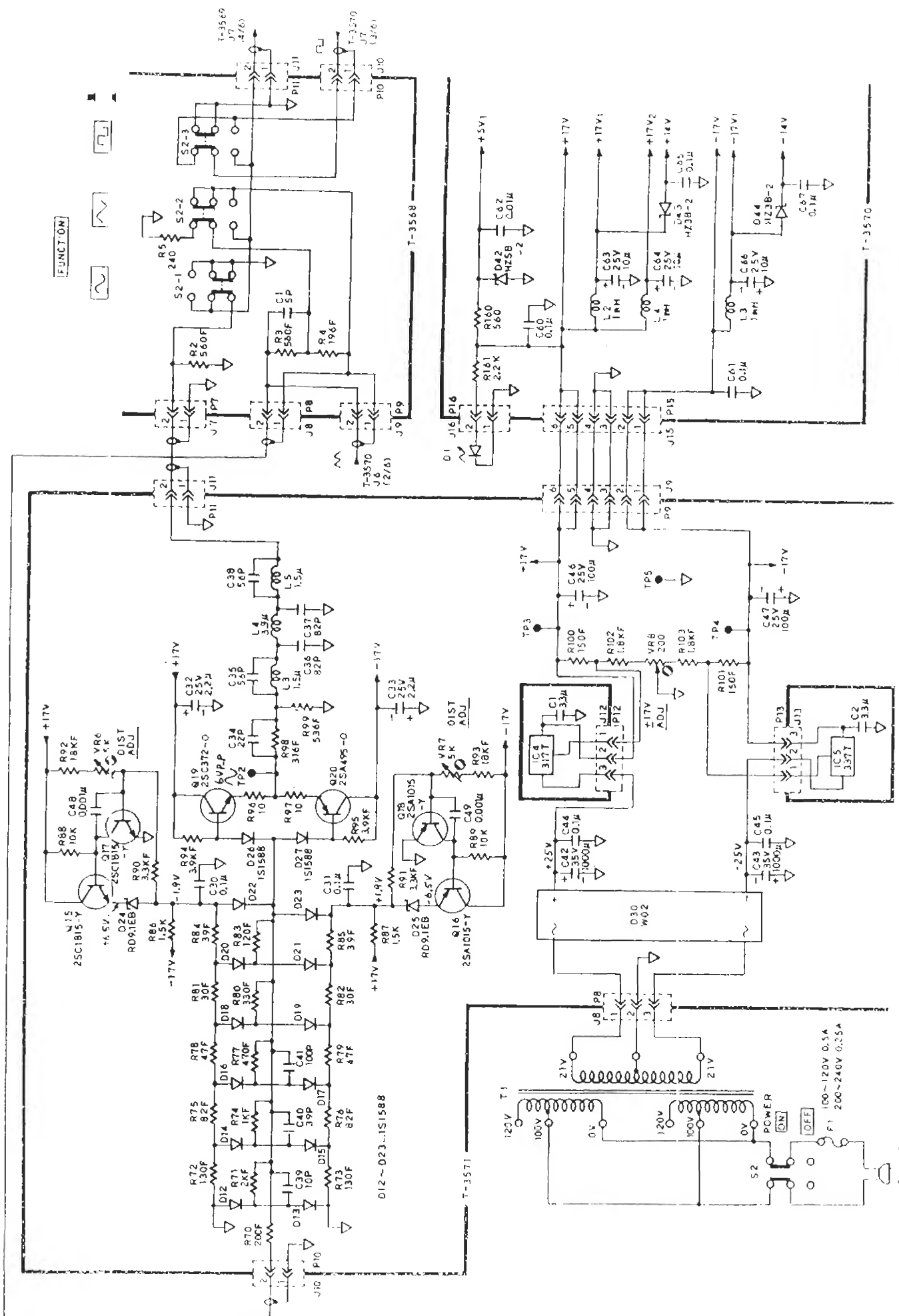
T-3569



SECOND GENERATOR, MODE SWITCH



AM Output Amplifier, Attenuator



Power supply, line converter, function switch

NO.	LDR PT NO.	DESCRIPTION	NO.	LDR PT NO.	DESCRIPTION
*** MAIN FRAME ***					
-RESISTORS-					
R1	1010512003	CARBON FILM	5.1K OHM	5% 1/4W	
R2	1010131007	CARBON FILM	150 OHM	5% 1/4W	
R10	1346113002	METAL FILM	61.1 OHM	1% 1/2W	
R11	1362473004	METAL FILM	347.5 OHM	5.5% 1/2W	
R12	1326909007	METAL FILM	69.0 OHM	1% 1/4W	
R13	1324930006	METAL FILM	493 OHM	1% 1/4W	
R14	1326129001	METAL FILM	61.2 OHM	1% 1/4W	
R15	1314990007	METAL FILM	499 OHM	1% 1/2W	
R16	1315493001	METAL FILM	54.9 OHM	1% 1/2W	
-VARIABLE RESISTORS-					
VR1	1340046003	PLASTIC	10K OHM 1.5% LIN. 1W "FREQ"		
VR2	1815008501	CARBON FILM	5K OHM 20% 1/8W "MOD LEVEL"		
VR3	1815011115	CARBON FILM	10K OHM 20% 1/8W "DC OFFSET"		
-CAPACITORS-					
C1	2470339008	ELECTROLYTIC	3.3uF	20% 35V	
C2	2470339008	ELECTROLYTIC	3.3uF	20% 35V	
-DIODE-					
D1	3130063000	LED	TLG164 "POWER"		
-INTEGRATED CIRCUITS-					
IC4	3210317009	REGULATOR	LM317T		
IC5	3210337005	REGULATOR	LM337T		
-TRANSFORMER-					
T1	3800537004	TRANSFORMER	Q-537		
-SWITCHES-					
S1	4000546019	ROTARY	S-546A "ATTENUATION"		
S2	4020138009	PUSH	E58-70702V "POWER"		
-FUSE-					
F1	4363735007	TIME LAG	3T4 250mA "180V-264V"		
F1	4363750003	TIME LAG	3T4 500mA "90V-132V"		
-CELLULAROUS-					
CON	4310714006	CONNECTOR	BNC 186		
FUSE	4371004003	FUSE HOLDER	FM-03246 35X31.8		
*** CONTROL BOARD ***					
-RESISTORS-					
R1	1010101002	CARBON FILM	100 OHM	5% 1/4W	
R2	1315600004	METAL FILM	560 OHM	1% 1/4W	
R3	1315600004	METAL FILM	560 OHM	1% 1/4W	
R4	1311960000	METAL FILM	196 OHM	1% 1/2W	
R5	1010241008	CARBON FILM	240 OHM	5% 1/4W	
-SWITCHES-					
S1	4000547002	PUSH	4000547002		
-PC BOARD-					
PC	5903569029	PC BOARD	5903569029		

NO.	LDR PT No.	DESCRIPTION	NO.	LDR PT No.	DESCRIPTION
*** MAIN BOARD					
R1	1312202004	METAL FILM	R56	1317501004	METAL FILM
R2	1311002000	METAL FILM	R57	1311001008	METAL FILM
R3	1311302002	METAL FILM	R58	1311001002	CARBON FILM
R4	1010682003	CARBON FILM	R59	1010103006	CARBON FILM
R5	1010103000	CARBON FILM	R60	1311001008	METAL FILM
R6	1315101006	METAL FILM	R61	1010681006	CARBON FILM
R7	1315101006	METAL FILM	R62	1010221002	CARBON FILM
R8	1010272009	CARBON FILM	R63	1010221002	CARBON FILM
R9	1316040008	METAL FILM	R64	1312701002	METAL FILM
R10	1312001004	METAL FILM	R65	1311272009	METAL FILM
R11	1312701002	METAL FILM	R66	1010152009	CARBON FILM
R12	1010182008	CARBON FILM	R67	1312200000	METAL FILM
R13	1312200000	METAL FILM	R68	1312200000	METAL FILM
R14	1316040008	METAL FILM	R69	1314640000	METAL FILM
R15	1312001004	METAL FILM	R70	1312200000	METAL FILM
R16	1311301000	METAL FILM	R71	1312200000	METAL FILM
R17	1324550006	METAL FILM	R72	1316490009	METAL FILM
R18	1312700000	METAL FILM	R73	1010121008	CARBON FILM
R19	1316040008	METAL FILM	R74	1010470003	CARBON FILM
R20	1010101002	CARBON FILM	R75	1010121008	CARBON FILM
R21	1010105000	CARBON FILM	R76	1010221002	CARBON FILM
R22	1010273001	CARBON FILM	R77	1321451006	METAL FILM
R23	1010102004	CARBON FILM	R78	1317500002	METAL FILM
R24	1312400003	METAL FILM	R79	1010101002	CARBON FILM
R25	1381005005	METAL FILM	R80	1010103006	CARBON FILM
R26	1384500021	METAL FILM	R81	1010103006	CARBON FILM
R27	1010101002	CARBON FILM	R82	1312060006	METAL FILM
R28	1010105000	CARBON FILM	R83	1312000002	METAL FILM
R29	1010273001	CARBON FILM	R84	1010331009	CARBON FILM
R30	1010102004	CARBON FILM	R85	1312000002	METAL FILM
R31	1312400003	METAL FILM	R86	1010181006	CARBON FILM
R32	1381005005	METAL FILM	R87	1010220000	CARBON FILM
R33	1384500021	METAL FILM	R88	1010472007	CARBON FILM
R34	1010220000	CARBON FILM	R89	1010331009	CARBON FILM
R35	1010100000	CARBON FILM	R90	1012222004	CARBON FILM
R36	1010682003	CARBON FILM	R91	1010222004	CARBON FILM
R37	1010103006	CARBON FILM	R92	1010511001	CARBON FILM
R38	1010101002	CARBON FILM	R93	1010123002	CARBON FILM
R39	1010561006	CARBON FILM	R94	1010682008	CARBON FILM
R40	1010100000	CARBON FILM	R95	1010472007	CARBON FILM
R41	1010100000	CARBON FILM	R96	1010302002	CARBON FILM
R42	1010101002	CARBON FILM	R97	1010470003	CARBON FILM
R43	1312004000	METAL FILM	R98	1312001007	METAL FILM
R44	1321933009	METAL FILM	R99	1311911007	METAL FILM
R45	1311202002	METAL FILM	R100	1311600000	METAL FILM
R46	1010101002	METAL FILM	R101	1010561006	CARBON FILM
R47	1312000002	METAL FILM	R102	1010272009	CARBON FILM
R48	1010472007	CARBON FILM	R103	1010222004	CARBON FILM
R49	1010101002	CARBON FILM	R104	1311201006	METAL FILM
R50	1010393001	CARBON FILM	R105	1318660000	METAL FILM
R51	1010100000	CARBON FILM	R106	1010162002	CARBON FILM
R52	1010101002	CARBON FILM	R107	1020222001	CARBON FILM
R53	1314301008	METAL FILM	R108	1312209008	METAL FILM
R54	1314701004	METAL FILM	R109	1010471005	CARBON FILM
R55	1010101002	CARBON FILM	R110	1010100000	CARBON FILM
			R111	1312709008	METAL FILM
			R112	1010390005	CARBON FILM

~VARIABLE RESISTORS-	
VR1	1211004089
VR2	1211004107
VR3	1940042609
VR4	140045001

-CAPACITORS-

No.	LDR PT No.	DESCRIPTION
(T-3570 CONT'D)		
C52	2120470016	NICR 500V
C53	2610474008	PLASTIC FILM 10% 470F
C54	2090016006	CERAMIC 63V 0.1uF
C55	2090016006	CERAMIC 50V 0.1uF
C56	2240220006	ELECTROLYTIC 25V 220F
C57	2120330001	NICR 500V 33F
C58	2240220006	ELECTROLYTIC 25V 220F
C59	2120470016	MICA 500V 470F
C60	2090016006	CERAMIC 50V 0.1uF
C61	2090016006	CERAMIC 50V 0.1uF
C62	2010103005	CERAMIC 25V 0.01uF
C63	2240100006	ELECTROLYTIC 25V 10uF
C64	2240100006	ELECTROLYTIC 25V 10uF
C65	2090016006	CERAMIC 25V 0.1uF
C66	2240100006	ELECTROLYTIC 25V 10uF
C67	2090016006	CERAMIC 50V 0.1uF
C70	2090016006	CERAMIC 50V 0.1uF
C71	2090016006	CERAMIC 50V 0.1uF
-VARIABLE CAPACITORS-		
V01	2910023009	CERAMIC 5-50PF 250V
V02	2910020003	CERAMIC 3.3-18PF 250V
V03	2910022007	CERAMIC 4-40PF 250V
V04	2910023009	CERAMIC 5-50PF 250V
V05	2910018006	CERAMIC 2.8-10PF 250V
-TRANSISTORS-		
Q1	3032362004	NPN 2SC362-G
Q1	3090036001	FET 2N5486
Q2	3011015005	PNP 2SA1016-G
Q3	3011015005	PNP 2SA1016-G
Q4	3011145006	PNP 2SA1145-G
Q5	3032362004	NPN 2SC362-G
Q6	2032705008	NPN 2SC2705-G
Q3	3031260000	NPN 2SC1260
Q9	3031260000	NPN 2SC1260
Q10	3010711007	PNP 2SA711
Q11	3031815003	NPN 2SC1815-0 or Y
Q12	3011015003	PNP 2SA1015-0 or Y
Q13	2031260000	NPN 2SC1260
Q14	3031260000	NPN 2SC1260
Q15	3010711007	PNP 2SA711
Q16	3010711007	PNP 2SA711
Q17	3010711007	PNP 2SA711
Q18	3031260000	NPN 2SC1260
Q19	3033596005	NPN 2SC3596-E
Q20	3011402000	PNP 2SA1402-E
Q21	3010711007	PNP 2SA711
Q22	3010495007	PNP 2SA495-G)TH-0
Q23	3010711007	PNP 2SA711
Q24	3033596005	NPN 2SC3596-E
Q25	3033596005	NPN 2SC3596-E
Q26	2050372003	FET 2SK372-V
Q27	3031815003	NPN 2SC1815-0 or Y
Q9	3011015003	PNP 2SA1015-0 or Y
Q19	3010495007	PNP 2SA495-G)TH-0
Q30	3010495007	PNP 2SA495-G)TH-0

No.	LDR PT No.	DESCRIPTION
(T-3570 CONT'D)		
Q31	3030752005	NPN 2SC752(G)TH-0
Q32	3030752005	NPN 2SC752(G)TH-0
-DIODES-		
D1	3120055004	ZENER RD11EB 11V
D2	3120055004	ZENER RD11EB 11V
D3	3110071005	SCHOTTKY 1S597
D4	3110006004	DETECTOR 1S1588
D5	3110006004	DETECTOR 1S1588
D6	3110071005	SCHOTTKY 1S597
D7	3110071005	SCHOTTKY 1S597
D8	3110006004	DETECTOR 1S1588
D9	3110006004	DETECTOR 1S597
D10	3110071005	SCHOTTKY 1S597
D11	3110006004	DETECTOR 1S1588
D12	3110006004	DETECTOR 1S1588
D13	3120027018	ZENER 05A27.5Y 7.5V
D14	3120027018	ZENER 05A27.5Y 7.5V
D15	3120028010	ZENER 05A28.2Y 8.2V
D16	3110006004	DETECTOR 1S1588
D17	3110006004	DETECTOR 1S1588
D18	3110006004	DETECTOR 1S1588
D19	3110006004	DETECTOR 1S1588
D20	3120030008	ZENER RD15EB 15V
D21	3110071005	SCHOTTKY 1S597
D22	3110071005	SCHOTTKY 1S597
D23	3120057017	ZENER 05A25.6X 5.6V
D24	3120057017	ZENER 05A25.6X 5.6V
D25	3120055004	ZENER RD11EB 11V
D26	3110006004	DETECTOR 1S1588
D27	3120079003	ZENER 05A22.4Z 2.4V
D28	3110071005	SCHOTTKY 1S597
D29	3110006004	DETECTOR 1S1588
D30	3110006004	DETECTOR 1S1588
D31	3110006004	DETECTOR 1S1588
D32	3120024003	ZENER RD5.1EB 5.1V
D33	3120054002	ZENER RD13EB 13V
D34	3110006004	DETECTOR 1S1588
D35	3110006004	DETECTOR 1S1588
D36	3120028001	ZENER RD8.2EB 8.2V
D37	3120028001	ZENER RD8.2EB 8.2V
D38	3110006004	DETECTOR 1S1588
D39	3110006004	DETECTOR 1S1588
D40	3120057017	ZENER 05A25.6X 5.6V
D41	3120057017	ZENER 05A25.6X 5.6V
D42	3120080003	ZENER HZ5B-2 4.7V
D43	3120081005	ZENER HZ3B-2 2.3V
D44	3120081005	ZENER HZ3B-2 2.3V
-INTEGRATED CIRCUITS-		
IC1	3220076000	OP AMP LF412
IC2	3220075008	OP AMP LF411
IC3	3220075008	OP AMP LF411
IC4	3220147007	OP AMP LT1008CN
IC5	3220147007	OP AMP LT1008CN
IC6	3220146005	OP AMP TL083CN
IC7	3090034007	TRANSISTOR ARPHY CA3046
IC9	3290010003	TTL 74F10 FC

No.	LDR PT. No.	DESCRIPTION	No.	LDR PT. No.	DESCRIPTION	No.
(T-3570 CONT'D)						
IC9	3090035009	TRANSISTOR ARRAY	CA3146 E			
IC10	3220075002	OP AMP	LF411			
IC11	3210710001	LINEAR	SN72710N			
IC12	3260006995	TTL	74LS00			
IC13	3220049007	REGULATOR	UFC78L05			
IC14	3220038002	OP AMP	TL082			
IC15	3210000001	TRANSISTOR ARRAY	LM3086			
IC16	3220048005	OP AMP	TL081CP			
-COILS-						
L1	3960478004	COIL	0.47UH	10%		
L2	3960109104	COIL	1MH	10%		
L3	3960109104	COIL	1MH	10%		
L4	3960109003	COIL	1UH	10%		
-SWITCH-						
S1	4000545008	ROTARY	J-545	'FREQ RANGE'		
-PC BOARD-						
	5963576024		T-3570B			
-MISCELLANEOUS-						
	4323019021	SOCKET	310-99-120			
*** POWER SUPPLY, AMPLIFIER BOARD T-3571 ***						
-RESISTORS-						
R1	1010390005	CARBON FILM	39 OHM	5%		
R2	1314990007	METAL FILM	499 OHM	1%		
R3	1010104008	CARBON FILM	100K OHM	5%		
R4	1010103006	CARBON FILM	10K OHM	5%		
R5	1010332001	CARBON FILM	3.3K OHM	5%		
R6	1311202003	METAL FILM	1.2K OHM	1%		
R7	1010233006	CARBON FILM	22K OHM	5%		
R8	1010233006	CARBON FILM	22K OHM	5%		
R9	1010332001	CARBON FILM	3.3K OHM	5%		
R10	1010913003	CARBON FILM	9.1K OHM	5%		
R11	1010233006	CARBON FILM	22K OHM	5%		
R12	1010912009	CARBON FILM	9.1K OHM	5%		
R13	1010470003	CARBON FILM	47 OHM	5%		
R14	1010470003	CARBON FILM	47 OHM	5%		
R15	1010102004	CARBON FILM	1K OHM	5%		
R16	1010102004	CARBON FILM	1K OHM	5%		
R17	1010122000	CARBON FILM	1.2K OHM	5%		
R18	1010122000	CARBON FILM	1.2K OHM	5%		
R19	1010220000	CARBON FILM	22 OHM	5%		
R20	1010220000	CARBON FILM	22 OHM	5%		
R21	1010181005	CARBON FILM	180 OHM	5%		
R22	1010241008	CARBON FILM	240 OHM	5%		
R23	1010470003	CARBON FILM	47 OHM	5%		
R24	1010470003	CARBON FILM	47 OHM	5%		
R25	1010102004	CARBON FILM	1K OHM	5%		
R26	1010102004	CARBON FILM	1K OHM	5%		
R27	1010102004	CARBON FILM	1.2K OHM	5%		
R28	1010122000	CARBON FILM	1.2K OHM	5%		
R29	1010220000	CARBON FILM	22 OHM	5%		
R30	1010220000	CARBON FILM	22 OHM	5%		
R31	1010200002	METAL FILM	200 OHM	1%		
R32	1312001004	METAL FILM	3K OHM	1%		
R33	1313000008	METAL FILM	130 OHM	1%		
R34	1311001008	METAL FILM	1K OHM	1%		
R35	1318209004	METAL FILM	92 OHM	1%		
R36	1318209004	METAL FILM	92 OHM	1%		
R37	1314700002	METAL FILM	47 OHM	1%		
R38	1314700002	METAL FILM	47 OHM	1%		
R39	1314700002	METAL FILM	47 OHM	1%		
R40	1313300000	METAL FILM	330 OHM	1%		
R41	1313009006	METAL FILM	30 OHM	1%		
R42	1313009006	METAL FILM	30 OHM	1%		
R43	1313909002	METAL FILM	120 OHM	1%		
R44	1313909002	METAL FILM	120 OHM	1%		
R45	1010152003	CARBON FILM	1.5K OHM	5%		
R46	1010152003	CARBON FILM	1.5K OHM	5%		
R47	1010103006	CARBON FILM	10K OHM	5%		
R48	1010103006	CARBON FILM	10K OHM	5%		
R49	1010103006	CARBON FILM	10K OHM	5%		

No.	LDR PT No.	DESCRIPTION	No.	LDR PT No.	DESCRIPTION
(T-357) CONT'D					
R90	1313301002	METAL FILM	C32	2240229004	ELECTROLYTIC
R91	1313301002	METAL FILM	C33	2240229004	ELECTROLYTIC
R92	1313302003	METAL FILM	C34	2120220000	MICA
R93	1311802002	METAL FILM	C35	2120560008	MICA
R94	1313901006	METAL FILM	C36	2120820008	MICA
R95	1313901006	METAL FILM	C37	2120820008	MICA
R96	1010100000	CARBON FILM	C38	2120560008	MICA
R97	1010100000	CARBON FILM	C39	2120100004	MICA
R98	1313160000	METAL FILM	C40	2120390009	MICA
R99	1315360000	METAL FILM	C41	2110101009	MICA
R100	1311500006	METAL FILM	C42	2320049004	ELECTROLYTIC
R101	1311500006	METAL FILM	C43	2320049004	ELECTROLYTIC
R102	1311801000	METAL FILM	C44	2090016006	CERAMIC
R103	1311801000	METAL FILM	C45	2090016006	CERAMIC
-VARIABLE RESISTORS-					
VR1	1711004006	CERMET	C46	2240101008	ELECTROLYTIC
VR2	1711004006	CERMET	C47	2240101008	ELECTROLYTIC
VR3	1711004006	CERMET	C48	2010102003	CERAMIC
VR4	1711004006	CERMET	C49	2010102003	CERAMIC
VR5	1711004079	CERMET	-VARIABLE CAPACITORS-		
VR6	1711004125	CERMET	VC1	2910018006	CERAMIC
VR7	1711004125	CERMET	-TRANSISTORS-		
VR8	1711004015	CERMET	Q1	3031260000	NPN
-CAPACITORS-					
C1	2120560008	MICA	Q2	3010711007	NPN
C2	2110221009	MICA	Q3	3031260000	NPN
C3	2120050005	MICA	Q4	3010711007	NPN
C4	2010104005	PLASTIC FILM	Q5	3032471009	NPN
C5	2120150009	MICA	Q6	3030372005	NPN
C6	2610104005	PLASTIC FILM	Q7	3010495007	NPN
C7	2610104005	PLASTIC FILM	Q8	3033596005	NPN
C8	2610104005	PLASTIC FILM	Q9	3011402000	NPN
C9	2110151004	MICA	Q10	3030382008	NPN
C10	2110181003	MICA	Q11	3030382008	NPN
C11	2240100006	ELECTROLYTIC	Q12	3010495007	NPN
C12	2240100006	ELECTROLYTIC	Q13	3030372005	NPN
C13	2240220006	ELECTROLYTIC	Q14	3010495007	NPN
C14	2240220006	ELECTROLYTIC	Q15	3031815018	NPN
C15	2010103005	CERAMIC	Q16	3011015012	NPN
C16	2010103005	CERAMIC	Q17	3031815018	NPN
C17	2090016006	CERAMIC	Q18	3011015012	NPN
C18	2240220006	ELECTROLYTIC	Q19	3030372005	NPN
C19	2090016006	CERAMIC	Q20	3010495007	NPN
C20	2240220006	ELECTROLYTIC	-DIODES-		
C21	2090016006	CERAMIC	D1	3120059000	ZENER
C22	2240220006	ELECTROLYTIC	D2	3110060004	DETECTOR
C23	2090016006	CERAMIC	D3	3110060004	DETECTOR
C24	2240220006	ELECTROLYTIC	D4	3110060004	DETECTOR
C25	2240330003	ELECTROLYTIC	D5	3110060004	DETECTOR
C26	2240330003	ELECTROLYTIC	D6	3110060004	DETECTOR
C27	2120100004	MICA	D7	3110060004	DETECTOR
C28	2120330001	MICA	D8	3120028001	ZENER
C29	2120270009	MICA	D9	3120059002	ZENER
C30	2090016006	CERAMIC	D10	3110060004	DETECTOR
C31	2090016006	CERAMIC	D11	3110060004	DETECTOR
C32	2090016006	CERAMIC	D12	3110060004	DETECTOR
				2.3-10pF	250V
				2.20F	20V
				2.20F	25V
				22pF	500V
				56pF	500V
				32pF	500V
				32pF	500V
				55pF	500V
				10pF	500V
				39pF	500V
				100pF	50V
				100pF	35V
				100pF	35V
				0.1uF	50V
				0.1uF	50V
				100pF	25V
				100pF	25V
				100pF	50V
				2.3-10pF	250V
				23C1260	
				23A711	
				23C1260	
				23A711	
				23C2471	
				23C3720TM-0	
				23A4950TM-0	
				23C3596-E	
				23A1402-E	
				23C382	
				23A4950TM-0	
				23C3720TM-0	
				23A4950TM-0	
				23C1815-Y	
				23A1015-Y	
				23C1815-Y	
				23A1015-Y	
				23C1815-Y	
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				23A1015-Y	
				23C1815-Y	
				23A1015-Y	
				23C1815-Y	
				23A1015-Y	
				23C1815-Y	
				23A1015-Y	
				23C1815-Y	

NO.	LOR PT No.	DESCRIPTION

< T-3571 CONT'D >		
D13	3110006004	DETECTOR 1S1588
D14	3110006004	DETECTOR 1S1588
D15	3110006004	DETECTOR 1S1588
D16	3110006004	DETECTOR 1S1588
D17	3110006004	DETECTOR 1S1588
D18	3110006004	DETECTOR 1S1588
D19	3110006004	DETECTOR 1S1588
D20	3110006004	DETECTOR 1S1588
D21	3110006004	DETECTOR 1S1588
D22	3110006004	DETECTOR 1S1588
D23	3110006004	DETECTOR 1S1588
D24	3120029003	ZENER RD9.1EB 9.1V
D25	3120029003	ZENER RD9.1EB 9.1V
D26	3110006004	DETECTOR 1S1588
D27	3110006004	DETECTOR 1S1588
D30	3110042008	BRIDGE RECTIFIER W-02
-INTEGRATED CIRCUITS-		
IC1	3220075008	OP AMP LF411
IC2	3220075008	OP AMP LF411
IC3	3211496010	BAL MOD MC1496L
-COILS-		
L3	3970159005	COIL 1.5UH 10%
L4	3970399005	COIL 3.9UH 10%
L5	3970159005	COIL 1.5UH 10%
-PC BOARD-		
	5903571026	T-3571B

9. CABINET REMOVAL

- Take four screws, holding cord wrappers, to remove the Top and Bottom cover.

